California Environmental Protection Agency
Department of Pesticide Regulation

Current Status of Volatile Organic Compound Emissions from Pesticides

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Overview

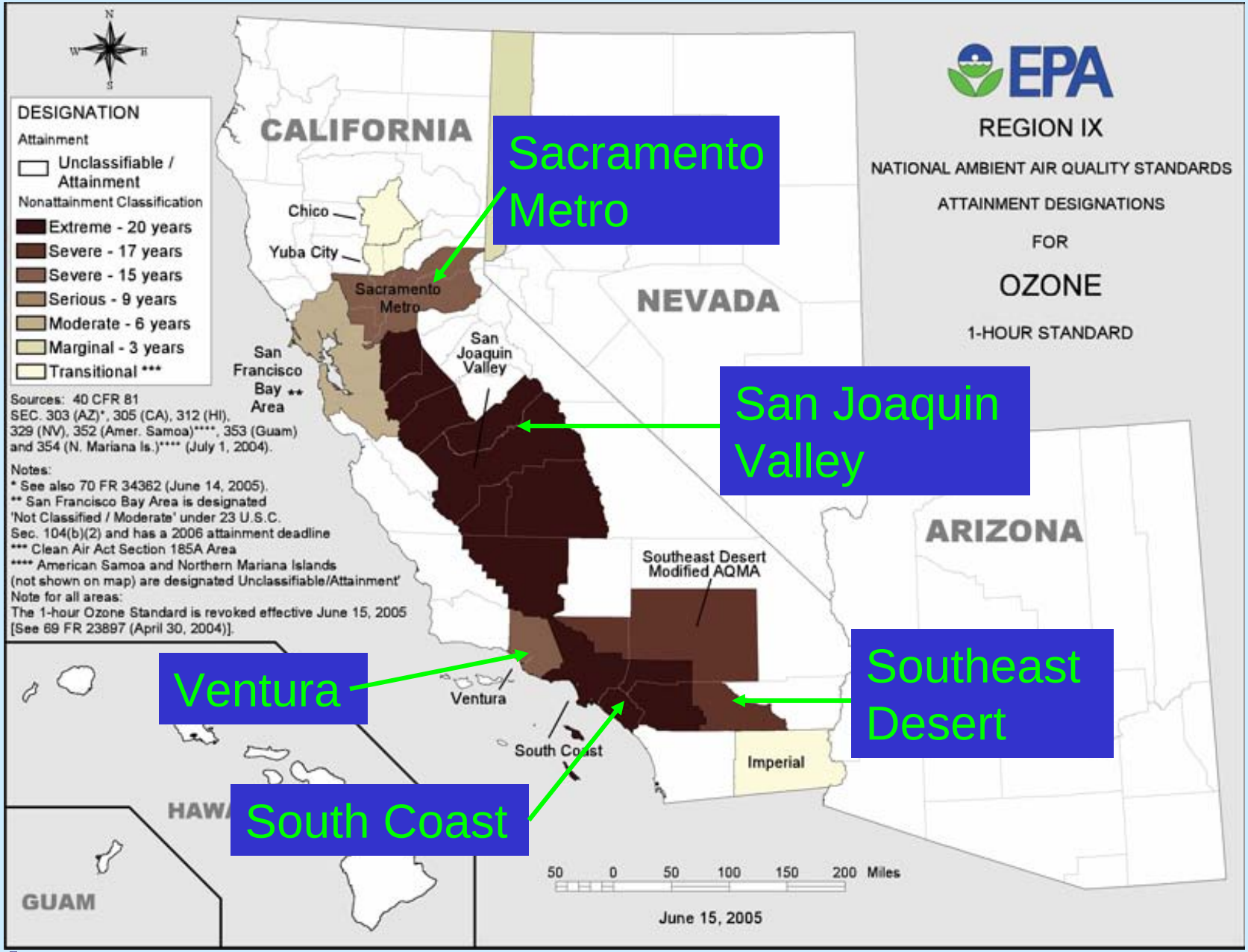
- Background
- Estimates of Pesticide VOC Emissions
- Regulatory Issues
- Changes to Method for Estimating Pesticide VOC Emissions
- Fumigant Regulations

Background

- Volatile organic compounds (VOCs) + nitrogen oxides (NOx) + sunlight **==>** ozone, a major air pollutant
- Many pesticide active and inert ingredients are VOCs
- Clean Air Act:

  ARB and APCD

  develop State Implementation Plans (SIPs) to reduce VOCs and NOx
- SIP requires state to:
  - track VOC and NOx emissions
  - reduce them by specified amounts in nonattainment areas


EPA
REGION IX
NATIONAL AMBIENT AIR QUALITY STANDARDS
ATTAINMENT DESIGNATIONS
FOR
OZONE
1-HOUR STANDARD
DESIGNATION
Attainment
Unclassifiable / Attainment
Nonattainment Classification
Extreme - 20 years
Severe - 17 years
Severe - 15 years
Serious - 9 years
Moderate - 6 years
Marginal - 3 years
Transitional ***
Sources: 40 CFR 81
SEC. 303 (AZ)*, 305 (CA), 312 (HI), 329 (NV), 352 (Amer. Samoa)****, 353 (Guam) and 354 (N. Mariana Is.)**** (July 1, 2004).
Notes:
* See also 70 FR 34362 (June 14, 2005).
** San Francisco Bay Area is designated 'Not Classified / Moderate' under 23 U.S.C. Sec. 104(b)(2) and has a 2006 attainment deadline
*** Clean Air Act Section 185A Area
**** American Samoa and Northern Mariana Islands (not shown on map) are designated Unclassifiable/Attainment'
Note for all areas:
The 1-hour Ozone Standard is revoked effective June 15, 2005 [See 69 FR 23897 (April 30, 2004)].
CALIFORNIA
NEVADA
ARIZONA
HAWAII
GUAM
Chico
Yuba City
Sacramento Metro
San Francisco Bay **
San Joaquin Valley
Southeast Desert Modified AQMA
Ventura
South Coast
Imperial
50 0 50 100 150 200 Miles
June 15, 2005
Sacramento Metro
San Joaquin Valley
Ventura
Southeast Desert
South Coast

1994 SIP DPR Requirements

- Develop & maintain pesticide VOC inventory, track emissions
- Implement regulations to achieve 20% reduction in five nonattainment areas (per court order)

Method for Estimating Pesticide VOCs

- DPR's inventory of VOC emissions:
  - agricultural and commercial structural applications of pesticide **products**
- VOC emission:

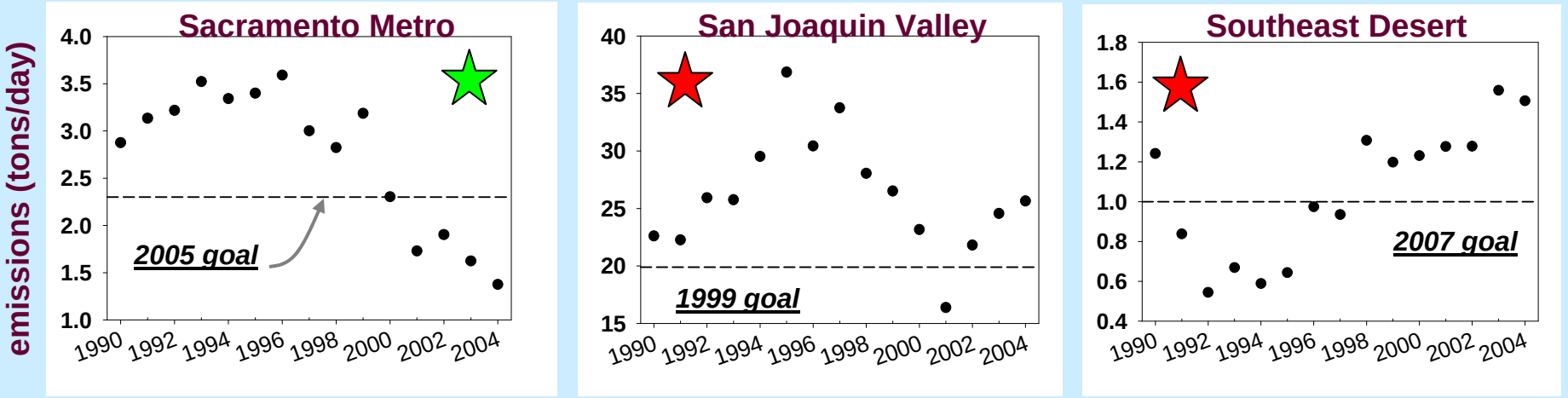
  emission = amount of product $_X$ *VOC fraction in product*

  - *Amount of product* from PUR
  - *VOC fraction* (emission potential, EP) determined by:
    - Lab test (thermogravimetric analysis, TGA)
    - Water/inorganic subtraction
    - Confidential statement of formula
    - Default value

Emission Inventory Calculations

- Emission inventory:
  - ag and commercial structural applications using PUR and EP data
- Emissions for each year beginning with base year (1990/1991)
- Inventory focuses on:
  - May – Oct (peak ozone period) each year
  - 5 nonattainment areas

1990 - 2004 May - October Pesticide VOC Emissions



Major Types of Pesticide VOCs (May-Oct 2004)

Nonattainment Area	Pesticide VOCs from Fumigants (%)	Pesticide VOCs from Emulsifiable Concentrates (%)
San Joaquin Valley	52	34
Southeast Desert	84	10
Ventura	93	3

Key Regulatory Issues

- DPR no longer in compliance with SIP
  - San Joaquin Valley
- Recently revised ozone standard
  - EPA revised ozone standard in 2004
  - New SIP required
  - requires VOC reductions beyond those in 1994 SIP
- Court order: DPR to reduce pesticide VOCs 20% of 1991 levels

Air Quality Initiative

- DPR's "Air Quality Initiative" addresses regulatory requirements and other air issues
  - Adopt innovative technologies
  - Establish pest management strategic partnerships
  - Reduce emulsifiable concentrate emissions
  - Reduce fumigant emissions

Adopt Innovative Technologies

- Long-term measures
- Precision agriculture
  - Equipment designed to improve application efficiency and reduce waste (e.g. special nozzles)
  - Variable rate technologies that change the rate of application according to variations in field conditions

Establish Pest Management Strategic Partnerships

- Long-term measure
- DPR is considering
  - Strategic partnerships
  - Pest-resistant and tolerant crops
  - Alternatives evaluation as part of restricted material permit process
  - Promotion of changes in commercially driven pesticide use (lenders, insurers, etc.)

Reduce Emulsifiable Concentrate Emissions

- DPR initiated reevaluation to request reformulation of approx 780 liquid products
- Establishes a 20% emission potential goal
- DPR considering VOC limit for new products

Reduce Fumigant Emissions

- Court order: regulations to achieve VOC reductions effective by 1/1/08
- Proposed regulations include:
  - Licensing requirements
  - Specific field fumigation methods
  - Records and reporting
  - Field fumigation emission limits
- Revisions to emission inventory methodology needed to account for field conditions

Calculation Revisions

- **VOC Inventory: numerous changes since 2002**
  - **improved accuracy**
    - **generic default emission potentials (EP)**
    - **special product chemistry-based EPs**
    - **additional products/application sites**
    - **outlier selection criteria**
    - **re-evaluation: EP data call-in ~700 products**
- **Objective: fumigant emissions under field conditions**
- **Revisions coordinated with proposed fumigant regs**

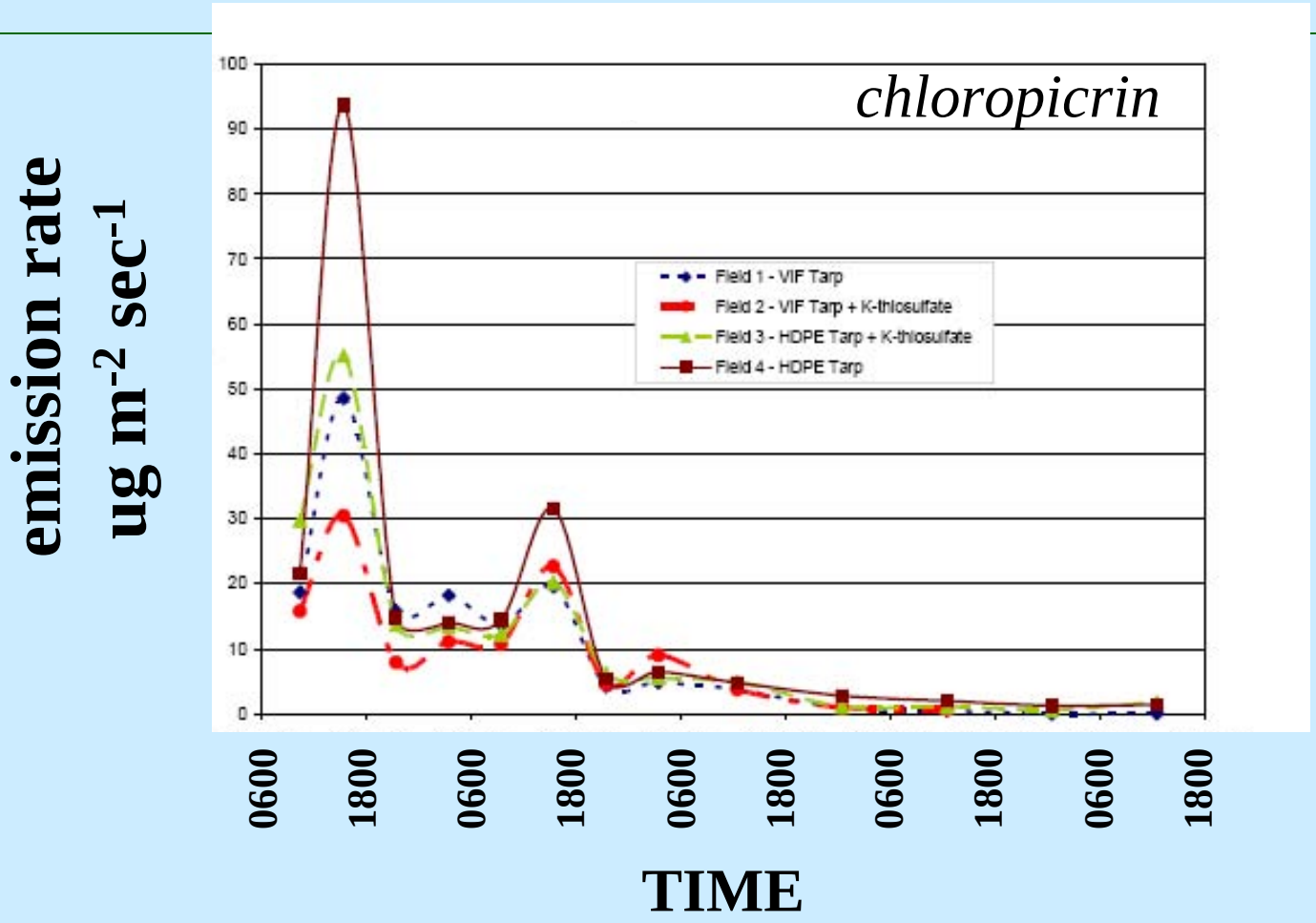
Proposed Calculation of Field Adjusted Emissions

- Old: Potential VOC emission

Emission = amount of product x EP

assumed 100% for fumigants

Emission vary under different application methods



"Methods to Reduce Fumigant Volatilization Losses from Agricultural Fields"
Husein Ajwa et al., *Proceedings 2007 California Plant and Soil Conference*

Proposed Calculation of Field Adjusted Emissions

- Old: Potential VOC emission

  Emission = amount of product x EP

- New: Field VOC emission for a specific fumigant, nonattainment area, and year is:

  Sum of (amount of AI x AMAF x MUF)

  AMAF = Application Method Adjustment Factor
  = fraction of fumigant actually emitted to air

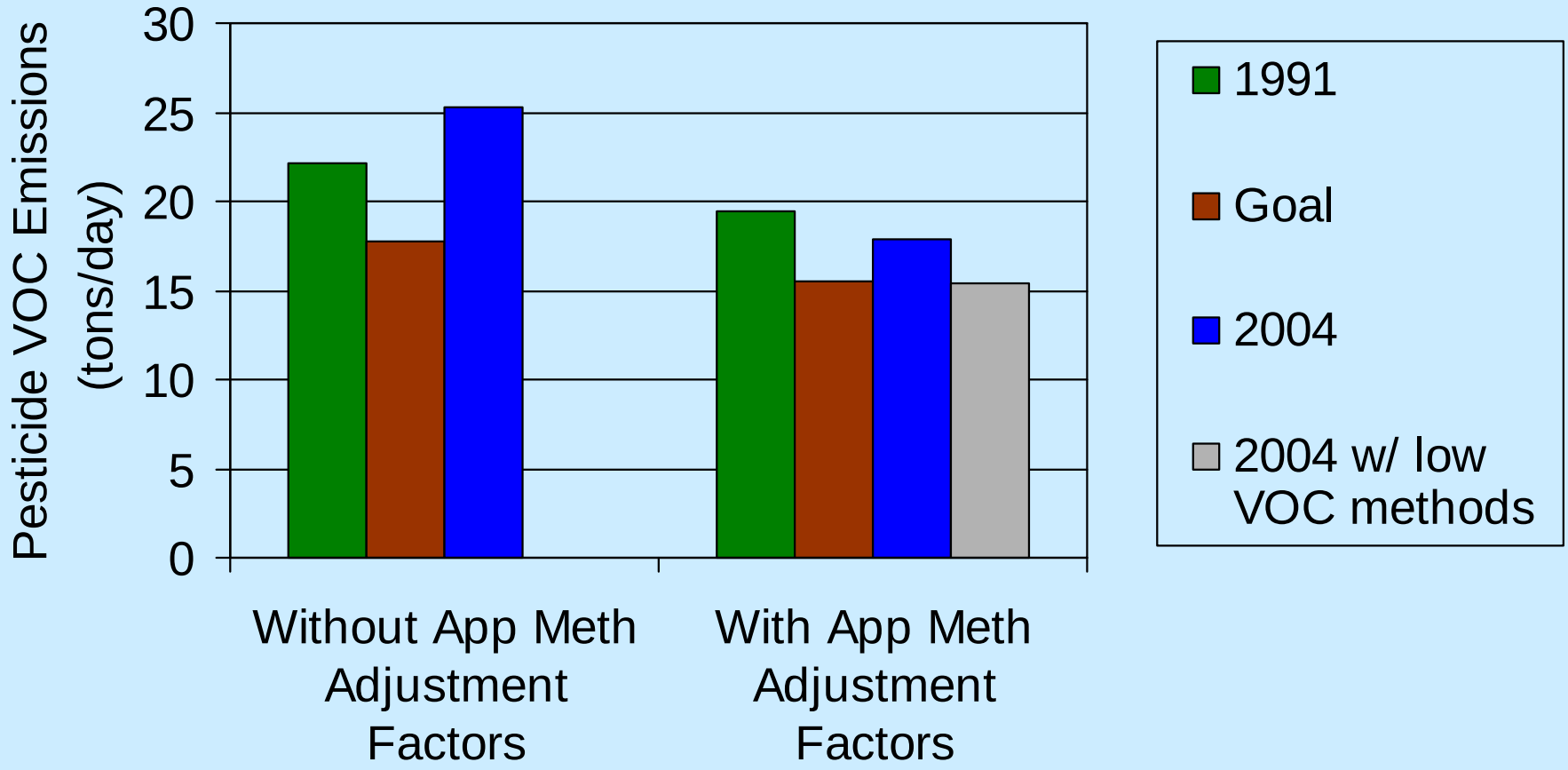
  MUF = Method Use Fraction
  = fraction of total applications

Example: Metam Adjusted Emissions, San Joaquin Valley, May-Oct 2004

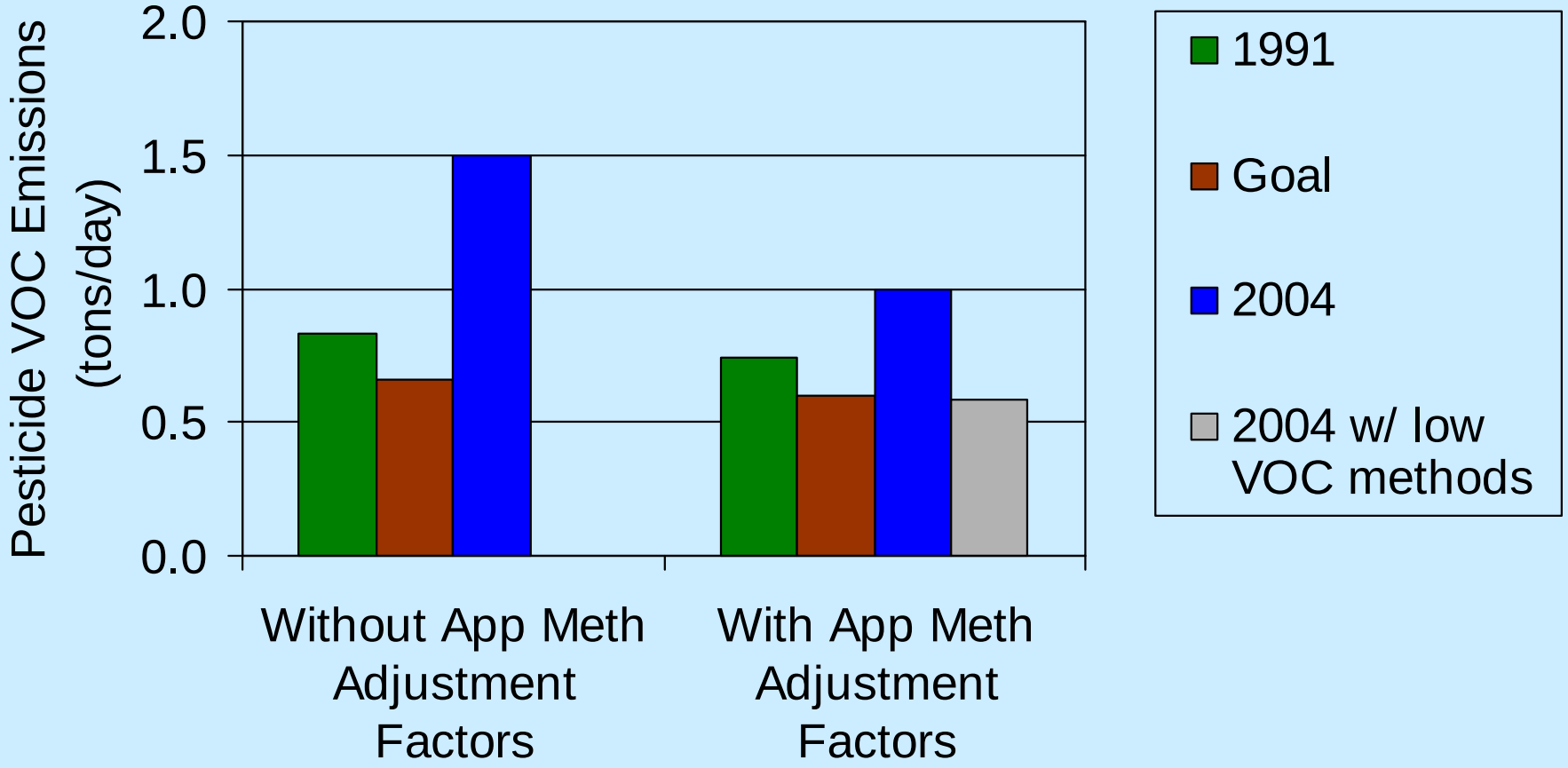
Metam Application Method	MITC Applied* (tpd)	AMAF (%)	MUF (%)	VOC Emissions (tpd)
Shallow injection, no tarp	6.3	77	21	1.02
Rototill or soil capping	6.3	14	20	0.18
Standard sprinkler	6.3	77	35	1.70
Drip	6.3	9	24	0.14
TOTAL	**6.3**	**---**	**---**	**3.04**

*MITC is the pesticidal breakdown product of metam

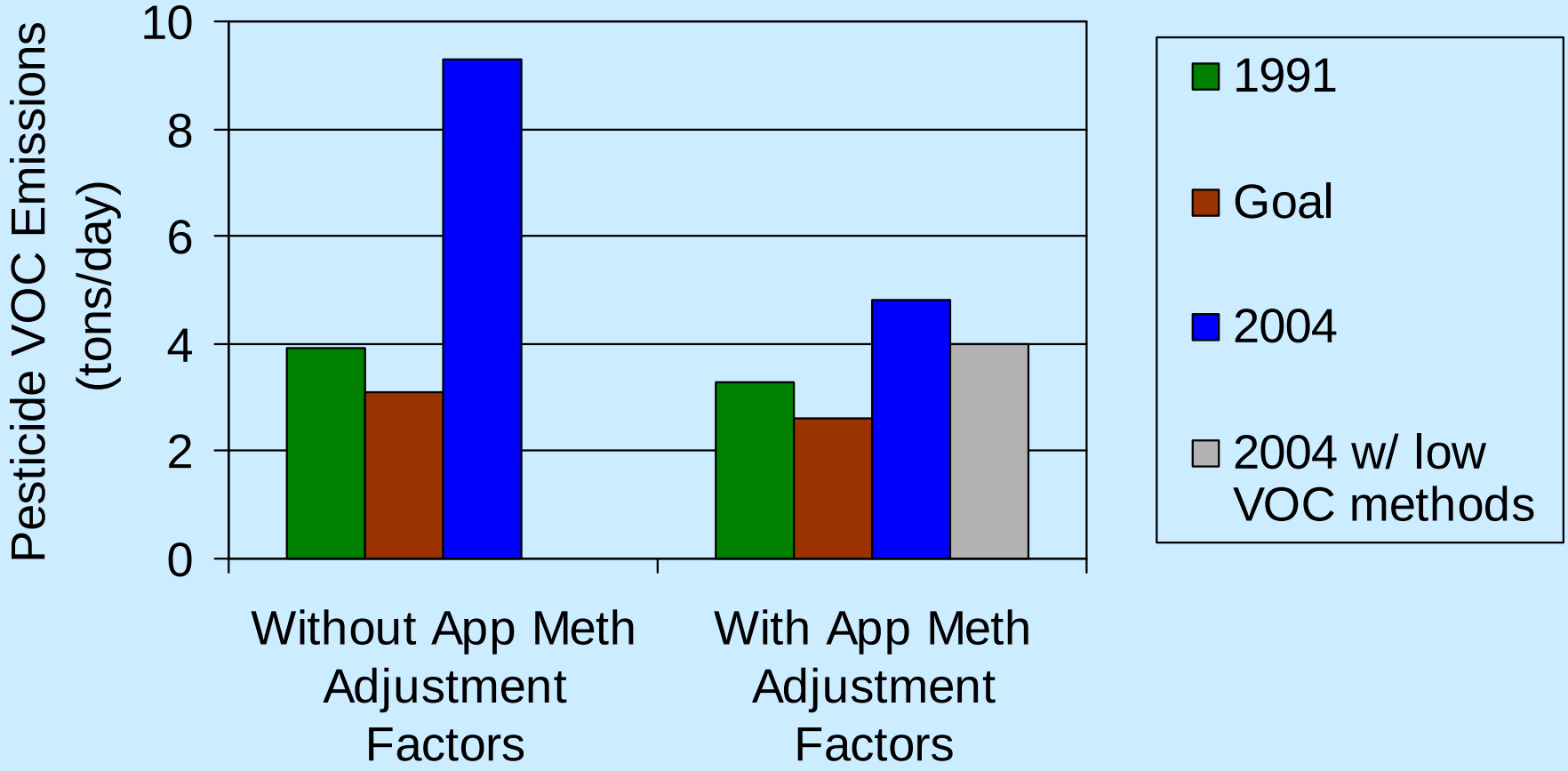
San Joaquin Valley Pesticide VOC Inventory



Southeast Desert Pesticide VOC Inventory



Ventura
Pesticide VOC Inventory



Pesticide VOC Research and Research Needs

- Emission inventory
- Emission reduction
  - Fumigants
  - Emulsifiable concentrates
  - Pest management
  - Innovative technologies
- Economics